



***The Electric Power Engineering Centre
'New Zealand's Centre for Excellence in Power'***

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SYNOPSIS

Since the launch of the Electric Power Engineering Centre (EPECentre or EPEC) in June 2002 with the support of New Zealand's electric power industry (via the Power Engineering Excellence Trust (PEET)), future prospects for power engineering in New Zealand is looking extremely positive. The EPECentre has been involved in facilitating and implementing a host of programmes, activities, and initiatives, including various field trips, onsite lectures, visiting lecturer programmes, premium scholarships, conferences, conventions, expos, market research, and work placement/graduate recruitment in the power industry – these have resulted in increased student enrolments in power courses at the University of Canterbury for three consecutive years (2003-2005), since the inception of EPEC. There are now around twice as many students enrolled in power courses compared to 2002 i.e. classes are twice as big, from as little as 14 students in 2002, to 35 in 2005 – an impressive 150% increase in just 3 years.

Consequently, this has also lead to a renewed interest in power engineering research and innovation in New Zealand, and the EPECentre has now become the focus point for this new directive, with the launch of New Zealand's first ever electric power engineering research and development programme in April 2005. The EPECentre is now focused on the facilitation and implementation of collaborative industry-academia research and development (R and D), *'a win-win for both academia and industry'*, while continuing with its successful initiatives to boost the quantity and the quality of power engineering graduates in New Zealand.

1. INTRODUCTION

The Electric Power Engineering Centre (EPECentre or EPEC) was launched in June 2002 with the support of New Zealand's electric power industry, via funding generated through the Power Engineering Excellence Trust (PEET), to promote and support power engineering excellence in New Zealand.

Three years since its inception, future prospects for power engineering in New Zealand is looking extremely positive. The EPECentre has been involved in facilitating and running a host of programmes, activities, and initiatives, including various field trips, onsite lectures, visiting lecturer programmes, premium scholarships, conferences, conventions, expos, market research, and work placement/graduate recruitment in the power industry – these have resulted in increased student enrolments in power engineering courses at the University of Canterbury for three consecutive years (2003-2005), following the establishment of the EPEC.

Consequently, this has also lead to a renewed interest in power engineering research and innovation in New Zealand, and the EPECentre has now become the focus point for this new directive, with the launch of New Zealand's first electric power engineering research and development programme in April 2005. The EPECentre is now focused on the facilitation and implementation of collaborative industry-academia research and development (R and D), *'a win-win for both academia and industry'*, as well as continue with its successful initiatives to boost the quantity and quality of power engineering graduates in New Zealand.

“Awareness and industry participation in education is the cornerstone in achieving future stability and sustainability for the industry”

Current industry supporters include- Premium Members: Contact Energy, Meridian Energy, Mighty River Power, Orion, Unison Networks, Transpower, Areva T&D, Vector Networks, and Genesis; **Standard Members:** EEA, BECA, ABB, Electrix, Maunsell, PB Power, MWH, Marlborough Lines, and Trust Power; **Non-Member Supporters:** PSC, and Network South

2. THE POWER REVIVAL

The successful EPECentre initiatives of the past three years have lead to the dawning of a new era for electric power engineering in New Zealand. The initial concern that prompted swift industry-academia action to propel the start-up of the Electric Power Engineering Centre has proven its value and shown credibility for its key founding supporters, and made believers out of many sceptics.

The results speak for themselves (see Table 1 below and Figures 1-5 for course intake comparisons and statistics on power graduates from the University of Canterbury 2000-2005).

	# of enrolled students					
	Pre EPECentre			Post EPECentre		
Academic Year	2000	2001	2002	2003	2004	2005
Total enrolled for 1st Pro.	95	106	107	81	108	110
Electrical Systems 1st Pro. (Compulsory 1 st Pro. Course)	95	106	107	81	108	110
% (# of enrolled students for course above / (total enrolled for 1 st Pro.)	100%	100%	100%	100%	100%	100%
Total enrolled for 2nd Pro.	113	94	99	106	97	105
Power Electronics 2nd Pro.	89	46	60	52	41	65
% (# of enrolled students for course above / (total enrolled for 2 nd Pro.)	79%	49%	61%	49%	42%	62%
Electric Power Engineering 2nd Pro.	41	20	26	37	38	45
% (# of enrolled students for course above / (total enrolled for 2 nd Pro.)	36%	21%	26%	35%	39%	43%
Total enrolled for 3rd Pro.	119	105	87	99	99	75
Power Electronics 3rd Pro.	44	49	23	41	38	30
% (# of enrolled students for course above / (total enrolled for 3 rd Pro.)	37%	47%	26%	41%	38%	40%
Power Systems 3rd Pro.	21	29	14	24	28	35
% (# of enrolled students for course above / (total enrolled for 3 rd Pro.)	18%	28%	16%	24%	28%	47%
Power Engineering Applications 3rd Pro.	15	25	16	21	28	35
% (# of enrolled students for course above / (total enrolled for 3 rd Pro.)	13%	24%	18%	21%	28%	47%

Table 1. University of Canterbury enrolment data for all power courses 2000-2005 *

***Note 1:** the cell colour coding in Table 1 indicates the same stock of students going through the three consecutive years of the 1st, 2nd, and 3rd Pro Electrical and Computer Engineering Degree. The colour coding can also be used to highlight dropouts/failures, and direct entry students for each batch as they progress through the three professional years.

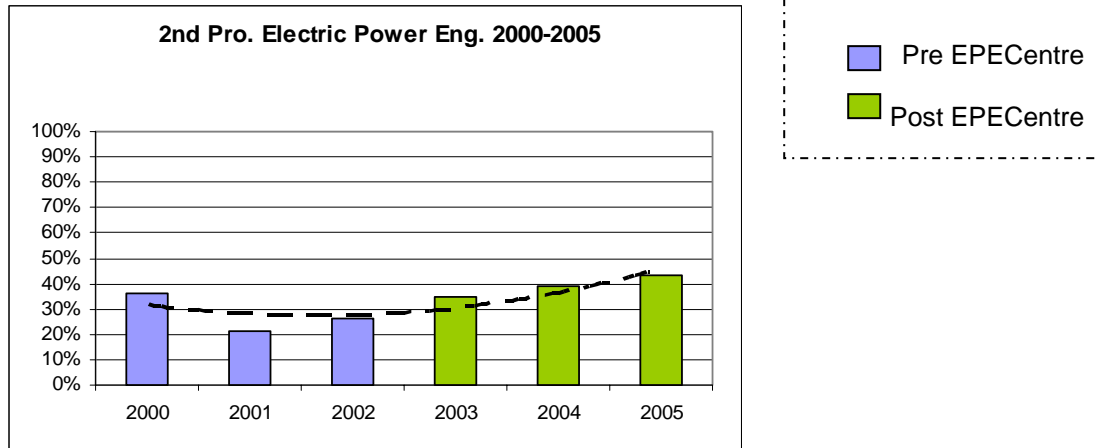


Figure 1. 2nd Pro Electric Power Engineering enrolments 2000-2005

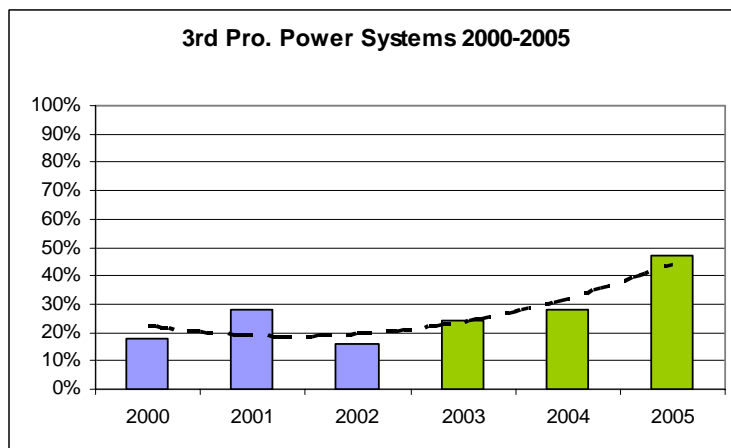


Figure 2. 3rd Pro Power Systems enrolments 2000-2005

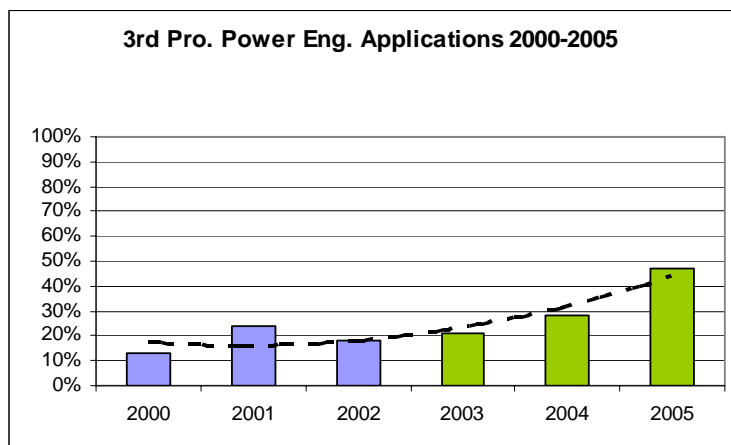


Figure 3. 3rd Pro Power Engineering Applications enrolments 2000-2005

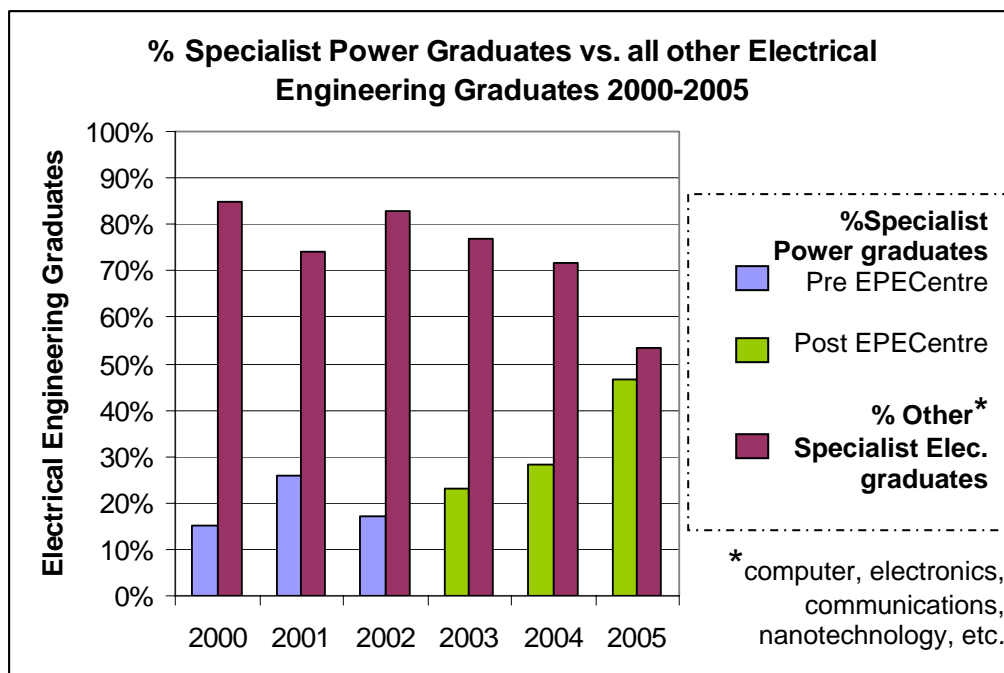


Figure 4. comparison of power graduates versus all other non-power electrical graduates

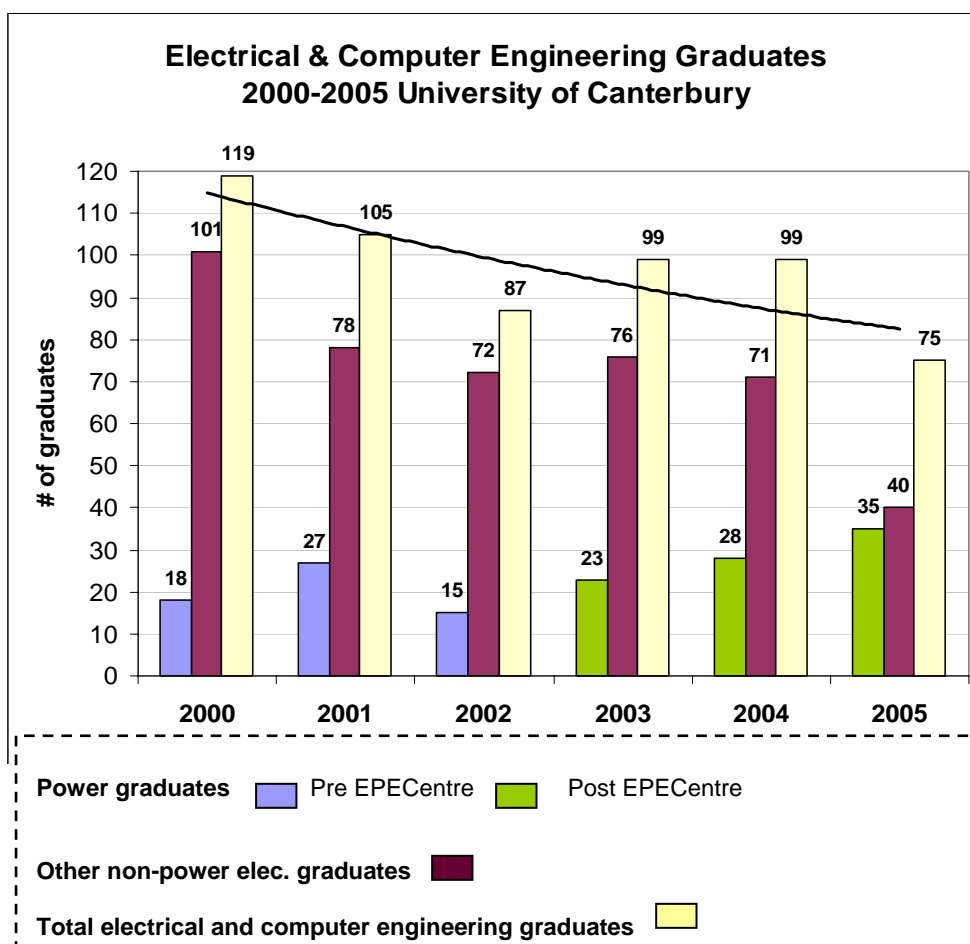


Figure 5. power graduate #s compared to all non-power electrical engineering graduates

Note 2. *specialist power graduates are defined for the purposes of this paper as students that take 3rd Pro Power Systems and 3rd Pro Power Engineering Applications; the graph excludes 3rd Pro. Power Electronics for clarity, as this is seen as a course that is common to many electrical engineering disciplines, including power; graduate number are averages based on enrolment numbers for 3rd Pro Power systems and Power Engineering Applications courses depicted in Table 1.*

The EPECentre was launched in mid 2002. Therefore, it had no effect on student enrolments until the new academic year of 2003. The data presented in the previous graphs stipulate the notable changes between enrolments pre-EPECentre 2000-2002 and post-EPECentre 2003-2005.

It is also important to observe the situation overseas, especially in Australia, where a recent study undertaken by the EESA (Electricity Energy Society of Australia) found that 276 graduate power engineers would be required annually to meet the looming industry shortage in Australia.¹

Hence, with Australia being approximately 7x larger in population than New Zealand (20 million compared to 3 million), this translates to an industry-wide need of around 39 graduate power engineers per year in New Zealand, i.e. $276 \div 7 = 39$, a need that has been closely met in 2005, with 35 power graduates (*see Figures 4 and 5 for details*).

Globally the situation is not that much better for power engineering, with India and China being the only nations producing high numbers of power engineering graduates, while in the United States, the production of power engineering graduates has dropped by 44% in less than 20 years.²

Key Observations:

- The pre-EPECentre era (prior to 2003) had significantly low rates of intake for power courses at the University of Canterbury
- The post-EPECentre era (2003 onwards) has resulted in a significant increase in power enrolments, over three consecutive years (2003-2005).
- An astonishing 47% (35 graduates) of all electrical and computer engineering graduates in 2005 can be classified as power engineers. Notably, this is the largest influx of potential power graduates into New Zealand industry for at least the last 6 years (*see Figure 5*).
- Class-size (i.e. # of students) of a number of power engineering courses are around twice as big as they use to be, e.g. 3rd Pro. Power Systems grew from 14 students in 2002 to 35 in 2005, a remarkable 150% increase in class size in 3 years.

¹ source: www.eesa.asn.au

² Source: Heydt G. and Vittal V. “IEEE Power and Energy Magazine”, Jan/Feb 2003, page(s) 38-45.

- An area for concern is the reduction in the number of electrical and computer engineering graduates in general, with an average intake over 2000-2005 of 100 students per year, 2005 has seen a staggering 25% decline in the number of graduates from the electrical and computer engineering discipline (an issue that the EPECentre will attempt to tackle in the coming years, additional to any action taken by the university).
- During the Pre-EPECentre era (2000-2002 in Figures shown), a pattern emerges that indicates that students took 2nd Pro Electric Power Engineering (almost as a filler course), with students discontinuing with power in their final 3rd Pro year (an average of 30% discontinued with final year power between 2000 and 2002) – a pattern that has improved in the post-EPECentre era (an average of only 13% have discontinued with final year power between 2003 and 2005) (*see Table 1. for raw data*).

***Note 3:** the impact of students failing and dropping out of university has not been accounted for in the previous calculation; calculation excludes power electronics for reasons explained previously in Note 2.*

- The average number of electrical engineering graduates per year is approximately 100, with an average of 20 specialist power graduates per year during the pre EPECentre era (2000-2002). This has grown to an average of 29 power graduates per year between 2003 and 2005 (post EPECentre era) – that is on average, an addition of 9 ‘more’ power graduates entering New Zealand industry each year! (*See Table 1. for raw data*).

“Since the start of the EPECentre, Electric power engineering is indeed going through a revival in New Zealand”

The prediction:

Over the long-term, the number of power graduates should level off at around 30-40 graduates per year, based on current enrolment trends at the University of Canterbury.

Important Observation - not apparent in data:

Power is now attracting a significant number of the top echelon of achievers in each academic year i.e. a large proportion of high caliber students are choosing power as a career option.

Reaching the Prediction:

Sustained industry support is now required to continue with the success of the EPECentre, as well as facilitate the introduction of newer and more innovative programmes and activities to win future student interest. An area that requires particular attention (focus) is electric power engineering research and development (R and D), which should help boost and maintain student interest and graduate numbers in power, as well as provide many synergistic benefits for both industry and academia.

3. THE MAGIC OF R AND D

Why is industry-academia collaborative Research and Development (R and D) good for industry, academics, students, universities, and the economy?

Industry:

- Get problems solved that cannot be tackled because of a lack of resources/outside core business/technical expertise/time limitations.
- Opportunity to develop commercially viable value-added solutions, and or innovative technology and/or spin-offs with commercial benefits, and/or gain competitive advantages.
- Involvement means promotion of individual organisations to potential future employees.
- Keeps academics in the university, which means sustainability for the future of the power discipline.
- Makes university degree content and educational experience more relevant for industry.
- Increases knowledge base and technical competency of an organisation, due to involvement in high level R and D.
- Sends strong supportive message to society, government, and future employees.
- Government/societal recognition for active role in improving systems and supporting knowledge growth in the energy sector.

Academics:

- Opportunity to live out research fantasies/dreams
- Active interaction with industry, which is also advantageous for advancement within the ranks of the academic sector.
- Opportunity to gain funding for innovative ideas (with commercial benefits)
- Salary boosts and prestige - working on funded research projects means income top-ups, as salaries in the academic sector are below industry rates.
- Temptation and incentive to stay at university and New Zealand.
- Boost knowledge base, and opportunity to apply high-end technical theory
- Opportunity to be inventor/innovator/entrepreneur.

Students:

- Attraction to pursue courses in the power area.
- Incentive to follow a career in power that is revived and showing signs of new technological development and innovation as a result of collaborative research.
- Opportunity to work on relevant industry projects that have applied outcomes.
- Applied research projects mean more excitement.
- Opportunity to impress and possibly gain graduate employment
- Opportunity to pursue postgraduate study by working on relevant industry projects.
- Potential to become young inventors/entrepreneurs – ‘important for a knowledge based economy’.
- Student will be better prepared for industry.
- Encourages the suitable few to consider the academic career path – a ‘vital’ area that is currently in decline, as a looming shortage of academics draws near.
- Incentive to stay in New Zealand after graduation i.e. they will begin to see future opportunities and a strong local industry support base.

University:

- Industry involvement in research means prestige as an active ‘research’ university
- Incentive to upgrade laboratory facilities
- Opportunity to attract government funding to match industry support.
- Boost research portfolio, and capability
- International repertoire for interdisciplinary industry-academia collaboration on projects.
- Marketing opportunity to attract high quality local/international students and academics.

Economy:

- Research supporting the energy supply system provides confidence for economic sustainability and growth.
- Spin-offs from R and D means growth of new industries
- Opportunity to move to a more knowledge based economy from a seemingly long overdrawn commodity based economy in New Zealand.
- Employment growth as new developments leads to new commercial ventures.
- Research reinforces New Zealand’s image as a developing 1st world nation internationally, making New Zealand seemingly more attractive to overseas investors.

Lessons Learned and the Way Forward

Electric power R and D in the USA is on the increase, with 3% predicted growth annually. This is greater than R and D spending for the computer, telecommunications, and aerospace industries i.e. a testament to a growing need for innovation and growth in the power sector for new and improved, more energy efficient, reliable, environmentally friendly technologies and systems - the United States is projected to spend US\$9.64 billion on electric power R and D for 2005.³

As a free and developing nation, New Zealand must also step-up to this challenge. New Zealand now has a vehicle and a platform to achieve exactly this, at least in the electric power and energy area via the Electric Power Engineering Centre - New Zealand’s very own centre for excellence in power engineering;

And a close examination of New Zealand’s demographics and current social environment indicates that there is only one, large scale specialist power engineering research group left in New Zealand (possibly even in Australasia), and that being the University of Canterbury, the host University of the Electric Power Engineering Centre.

The EPECentre along with its strong New Zealand wide pan-industry network, and together with the University of Canterbury, has an opportunity to make New Zealand the ‘epicenter’ for power engineering excellence in Australasia.

The EPECentre and its partners must improve upon the standard of excellence in research currently practiced in academia and industry, and further the cause of

³ source: R&D Magazine

technology development and system studies for reliability and improvement in the energy supply sector

A recent study conducted by a U.S. firm states that universities are far bigger accelerators for business growth and job growth than given credit for. The study credits this to the impact achieved by a having strong industry backed support-base and plenty of collaborative industry-academia research and development, which results in technology transfer into industry and the commercialisation of new technologies, all adding to further the cause. Special mention is given to institutions such as MIT (Massachusetts Institute of Technology) etc. for the way in which organisations of the like have achieved lasting success through collaborative research.⁴

However, it is important to note that the New Zealand platform is rather different to the environment that these organisations in the U.S. grew and thrived in, and certainly times have changed, so what was successful then may not be necessarily as successful now – Nevertheless, too much analysis on this consumes precious time and only diminishes the window of opportunity, the most efficient and only plausible way forward is to take action. According to leading organisational researchers from Stanford University in the U.S., the biggest downfall for organisations on the verge of lasting success is to narrow the window of opportunity by substituting talk for ‘action’.⁵

There is truth to the simple but meaningful phrase that *‘action speaks louder than words’*. The value of this simple phrase has already been fostered in New Zealand through its ‘kiwi’ cultural identity as a *‘can and will do’* nation.

Action Plan:

‘furthering collaborative electric power R and D in New Zealand and establishing lasting success for New Zealand’s very own Centre for Excellence in Power’

- Individual industry organisations or groups of industry sectors to develop a ‘wish list’ of key problem or opportunity areas facing individual organisation and/or industry sectors e.g. generation sector.
- Communicate the issues relating to each industry sector issue and or individual organisation issue to the Electric Power Engineering Centre
- Develop and shape projects around the issue(s).
- The Electric Power Engineering Centre develops a project plan (including resources (personnel and equipment), timelines, and budgets) to tackle the issue in coordination with the organisation(s) concerned or with representatives from the concerned industry sector e.g. lines companies.

⁴ source: www.innovationassoc.com

⁵ source: Pfeffer J. and Sutton R. *“The Knowing-Doing Gap”*, Harvard Business School Press, Boston, USA 2000.

- Establish funding routes to undertake project(s), either in the form of individual organisational funding, joint organisational funding, and/or group sector funding, as well as investigate options for government funding.
- The industry project partners play an advisory support role during the course of each project, knowing that the work is being conducted professionally, and to the highest industry standard.
- This process of collaborative R and D has been expedited with the launch of New Zealand's first Electric Power Engineering R and D Programme by the EPECentre in April 2005 – the pending action is now with industry to approach the EPECentre with potential research issues or new ideas.
- The EPECentre draws on a wide range of technical expertise from within the University of Canterbury and other external international institutions (through its network) to enable multidisciplinary research and development. The centre also employed its first Research Engineer to support its R and D capability in March 2005.
- EPECentre has already initiated a number of collaborative projects, including a 12 month joint project with Orion NZ and Enermet Limited to research flicker issues on distribution networks, and a MOU with Antarctica New Zealand to research renewable energy options for Antarctica, as well as conducting R and D on the worlds first partial-core high temperature superconducting (HTS) transformer in partnership with Meridian Energy.

Constant Focus on the Future:

“Improving upon the standard of excellence and the value of thinking long-term”

A university provides valuable resources for industry, and the current way the EPECentre operates means that the flow of information is open and linkages are already in place within industry to facilitate collaborative industry-academia research and development.

Strong leadership from both industry and academia is a prerequisite for success in the collaboration game. The EPECentre in New Zealand has proven this theory, by working closely with industry partners for the past three consecutive years and producing high levels of success to meet short-term and long-term industry needs, especially in terms of reviving power engineering at the University of Canterbury, sustaining power curriculum in New Zealand, facilitating graduate/student recruitment, promoting industry, supporting professional development, and the establishment of a strong network built on relationships and mutual understanding.

Not only is academia a rich source of R and D, it is also the breeding ground for future industry stars. The supply of skilled technicians in the technology trades area to support engineers and researchers in R and D is also a key ingredient. Hence, partnering with organizations such as ESITO (Electricity Supply Industry Training Organisation) is of strategic importance.

New Zealand now has the framework via the EPECentre and the Power Engineering Excellence Trust, along with its industry partners, including networks such as the Electricity Engineers Association (EEA), to exchange ideas, keep informed on current industry issues and developments, tackle problems, and investigate new and exciting opportunities within the power area.

“Long-term vision is needed to make New Zealand’s high-tech power engineering future a reality - the Electric Power Engineering Centre is the vehicle for this journey”

4. CONCLUSION

Since the inception of the Electric Power Engineering Centre in 2002, there has been a dramatic turnaround in enrolments for power engineering courses at the University of Canterbury (for three consecutive years). Furthermore, approximately 50% of all electrical and computer engineering graduates in 2005 will be specialist electric power engineers, which represents one of the largest influxes of power graduates into New Zealand industry for at least the last 6 years– *“a power revival is truly underway in New Zealand”*.

Consequently, this has also lead to a renewed interest in power engineering research and innovation in New Zealand, and the EPECentre has now become the focus point for this new directive, with the launch of New Zealand’s first electric power engineering research and development programme in 2005.

The EPECentre is now focused on the facilitation and implementation of collaborative industry-academia research and development (R and D), an area that will provide synergist benefits for both academia and industry.

In conclusion, the highway of opportunity is open to make New Zealand the ‘epicenter’ of power engineering excellence in Australasia - the Electric Power Engineering Centre is fueled and ready to make this journey...

“The POWER of industry participation in education can no longer be doubted...”

***The Electric Power Engineering Centre
‘New Zealand’s Centre for Excellence in Power’***

www.epecentre.ac.nz